CHEMICAL DIAGRAMS

OF THE

LONDON PHARMACOPŒIA

WHITAKER.

The gift of Mr M

June 1847

Davidson. M.D. E.
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DIAGRAMS

EXPLANATORY OF THE

CHEMICAL DECOMPOSITIONS

OF THE

LONDON PHARMACOPŒIA,

AND OF

THE VARIOUS PROCESSES USED IN MEDICAL CHEMISTRY

NECESSARY TO BE KNOWN BY STUDENTS

PREPARING FOR EXAMINATION AT APOTHECARIES' HALL.

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PREFACE.

In compiling this little Work it has been my object to exhibit to the Medical Student, in as brief and perspicuous a manner as possible, the nature of the processes used in medical chemistry. I have confined myself to the use of diagrams alone in illustrating such processes as are met with in the Pharmacopœia, leaving the Student to consult the excellent Work of Mr. Phillips for a more detailed explanation; but of those which are adopted in the preparation of articles of the Materia Medica, and in the detection of Poisons, I have added short accounts, carefully drawn from the most authentic sources.

The figures used in the construction of the Diagrams relate to the number and not to the weights of the equivalents; the student, however, must not suppose that a knowledge of the atomic weights of bodies is deemed unnecessary; far otherwise; I therefore recommend him to study attentively the Table given at the end, displaying the classes into which simple bodies have been divided by chemists, their names, the weight of their equivalents, their specific gravity, and the compounds which they form with oxygen. By committing to memory these particulars respecting the more common simple substances, the progress of the Student will be greatly facilitated.

T. H. WHITAKER.

1, Maze Pond, Southwark,
June 29, 1839.

CHEMICAL DIAGRAMS

OF THE

LONDON PHARMACOPŒIA.

ACIDUM ACETICUM.

Composition.
- 4 Carbon .... = 24
- 3 Oxygen..... = 24
- 3 Hydrogen.. = 3

51 Equivalent.

Before decomposition.		After decomposition.
Acetate of Soda.........	Acetic Acid.......	Acetic Acid, containing 30·8 per cent. of real acid.
	Water	
	Soda	
Diluted Sulphuric Acid.	Water	
	Sulphuric Acid	Anhydrous Sulphate of Soda.

ACIDUM CITRICUM.

Composition.
- 4 Carbon ..... = 24
- 4 Oxygen .... = 32
- 2 Hydrogen .. = 2

58 Equivalent.

Before decomposition.		After decomposition.
Chalk.........	Carbonic Acid................	Off as Gas.
	Lime	Citrate of Lime.
Lemon juice.	Citric Acid	
	Mucilage, &c.................	Remain.

Citrate of Lime.........	Citric Acid	In solution.
	Lime	
Diluted Sulphuric Acid.	Water	
	Sulphuric Acid. ...	Sulphate of Lime.

ACIDUM HYDROCHLORICUM.

Composition.
- 1 Hydrogen.... = 1
- 1 Chlorine ..... = 36

37 Equivalent.

Liquid Sulphuric Acid, 1 eq.	Water 1 { Hydrogen…… 1		1 Hydrochloric Acid.
	Oxygen……… 1		
	Sulphuric Acid……… 1		
Chloride of Sodium, 1 eq.	Chlorine……………… 1		
	Sodium………………… 1		1 Sulphate of Soda.

ACIDUM HYDROCYANICUM.

Composition. { 1 Hydrogen…. = 1; 1 Cyanogen…. = 26

27 Equivalent.

Composition of Ferrocyanide of Potassium.	1 Cyanide of Iron………	54
	2 Cyanide of Potassium…	132
	3 Water………………	27
		213 Equivalent.

Ferrocyanide of Potassium, 2 eqs.	Cyanide of Iron……. 2		1 Bi-ferrocyanide of Iron.
	Cyanide of Potassium.. 1		
	Cyanide of Potassium.. 3	Cyanogen.. 3	3 Hydrocyanic Acid.
		Potassium.. 3	
	Water……………. 6	Hydrogen.. 3	
		Oxygen….. 3	
		Water….. 3	
Sulphuric Acid		……………… 6	3 Bisulphate of Potassa.

EXTEMPORANEOUS PROCESS.

Hydrochloric Acid, 1 eq.	Hydrogen…. 1	1 Hydrocyanic Acid.
	Chlorine…… 1	
Cyanide of Silver, 1 eq.	Cyanogen …. 1	
	Silver…….. 1	1 Chloride of Silver.

ACIDUM NITRICUM.

Composition. { 5 Oxygen…. = 40; 1 Nitrogen… = 14

54 Equivalent.

Before decomposition.		After decomposition.
Nitrate of Potassa, 2 eqs.	Nitric Acid……… 2	2 Liquid Nitric Acid.
	Potassa ………… 2	
Liquid Sulphuric Acid, 4 eqs.	Water ………… 3	
	Water………… 2	
	Sulphuric Acid….. 4	2 Bisulphate of Potassa.

ACIDUM PHOSPHORICUM.

Composition. { 5 Oxygen…. = 40; 2 Phosphorus = 32

72 Equivalent.

2. 2CyK 1CyFe { 3Cy, 1Cy, 3K, 1K, 2CyFe }

{ 3H, 3O }

6SO3

3CyH

CyK2CyFe

3, 2SO3KO

Nitric Acid.	Nitric Oxide......................	Off as Nitrous Acid Gas.
	Oxygen.............	
Phosphorus...........................		Phosphoric Acid.

ACIDUM TARTARICUM.

Composition.	4 Carbon	= 24
	5 Oxygen......	= 40
	2 Hydrogen	= 2
		66 Equivalent.

Before decomposition.			After decomposition.
A.			
Bitartrate of Potassa, 1 eq.	Tartrate of Potassa	1	In solution.
	Tartaric Acid	1	Tartrate of Lime.
Carbonate of Lime, 1 eq.	Lime	1	
	Carbonic Acid......	1	Off as gas.
B.			
Carbonate of Lime, 1 eq.	Carbonic Acid...............	1	1 Off as gas
	Lime ....1 — Oxygen	1	1 Water
	Calcium	1	
Hydrochloric Acid, 1 eq...	Hydrogen......	1	
	Chlorine	1	1 Chloride of Calcium.
C.			
Chloride of Calcium, 1 eq.	Chlorine..............	1	1 Chloride of Potassium.
	Calcium	1	
Tartrate of Potassa, 1 eq.	Potassa 1 — Potassium ..	1	
	Oxygen.....	1	
	Tartaric Acid	1	1 Tartrate of Lime.
D.			
Tartrate of Lime.	Tartaric Acid.............		In solution.
	Lime..................		
Diluted Sulphuric Acid.	Water.................		
	Sulphuric Acid...........		Sulphate of Lime.

LIQUOR AMMONIÆ.

Composition of Ammoniacal Gas.	1 Nitrogen......	= 14
	3 Hydrogen.....	= 3
		17 Equivalent.

Hydrochlorate of Ammonia.	Ammonia....	Liquor Ammoniæ.
	Hydrogen....	
	Chlorine.....	
Lime.	Oxygen......	
	Calcium......	Chloride of Calcium.

AMMONIÆ SESQUICARBONAS.

Composition.	1½ Carbonic Acid....	= 33
	1 Ammonia..........	= 17
	1 Water............	= 9
		59 Equivalent.

Hydrochlorate of Ammonia. { Ammonia.... Hydrogen .... Chlorine.... —— Hydrated Sesquicarbonate of Ammonia.

Carbonate of Lime. { Carbonic Acid Oxygen....... Calcium...... —— Chloride of Calcium.

LIQUOR AMMONIÆ ACETATIS.

Sesquicarb. of Ammonia. { Carbonic Acid............Off as Gas.
Ammonia....

Distilled Vinegar............——————Acetate of Ammonia.

MORPHIÆ HYDROCHLORAS.

Composition. { 1 Hydrochloric Acid.... = 37
1 Morphia............. = 284

321 Equivalent.

Solution of Opium. { Morphia...... Meconic Acid. —— Hydrochlorate of Morphia.

Water. { Hydrogen ... Oxygen......

Chloride of Lead. { Chlorine..... Lead......... —— Meconate of Lead.

MORPHIA.

Before decomposition. After decomposition.

Hydrochlorate of Morphia. { Morphia .... —————— Morphia Precip.
Hydrochloric Acid .

Ammonia ....——————Hydrochlorate of Ammonia.

QUINÆ DISULPHAS.

Composition. { 2 Quina .... = 324
1 Sulphuric Acid..... = 40
8 Water............ = 72

436 Equivalent.

A.

Acidulated Decoction of Cinchona. { Kinate of Quina......——————In solution.
Sulphuric Acid.......

Hydrated Oxide of Lead................——————Sulphate of Lead.

B.

Ammonia ....——————Kinate of Ammonia.

Kinate of Quina. { Kinic Acid ....
Quina 2

Sulphuric Acid............ .... 1 ——————Disulphate of Quina.

STRYCHNIA.

A.

Magnesia..... ....——————Strychnate of Magnesia.

Nux Vomica. { Strychnic Acid...
Strychnia.......

Sulphuric Acid..................——————Sulphate of Strychnia.

B.

Ammonia .... —— Sulphate of Ammonia.

Sulphate of Strychnia. { Sulphuric Acid ....
Strychnia .... —— Strychnia precipitated.

VERATRIA.

A.

Gallate of Veratria. { Gallic Acid .... —— Super gallate of Veratria.
Veratria ....

Sulphuric Acid .... —— Sulphate of Veratria.

B.

Magnesia .... —— Gallate of Magnesia.

Magnesia .... —— Sulphate of Magnesia.

Super gallate and Sulphate of Veratria. { Gallic Acid ......
Sulphuric Acid ...
Veratria ....

Sulphuric Acid .... —— Sulphate of Veratria.

C.

Ammonia .... —— Sulphate of Ammonia.

Sulphate of Veratria. { Sulphuric Acid ......
Veratria .... —— Veratria precipitated.

ÆTHER SULPHURICUS.

Composition. { 4 Carbon .... = 24
1 Oxygen .... = 8
5 Hydrogen .. = 5

37 Equivalent.

Before decomposition. After decomposition.

Sulphovinic Acid, 1 eq. { Alcohol 2. { Carbon ...... 4 —— 1 Æther distills over.
Hydrogen 5
Hydrogen 1
Oxygen 1
Oxygen 1
Sulphuric Acid .... 2 —— Remain in the retort.

CORNU USTUM.

Horn. { Gelatine .... Driven off by heat.
Phosphate of Lime —— Remains.

ANTIMONII OXYSULPHURETUM.

A.

Composition. { 1 Sesquioxide of Antimony .... = 77
5 Sesquisulphuret of Antimony ..... = 445
8 Water .... = 72

594 Equivalent.

Sesquisulphur. of Antimony, 6 eq. { Sesquisulphuret of Antimony 5
Antimony .. 1 —— Sesquioxide of Antimony 1
Sulphur ... $1\frac{1}{2}$

Potassa, $1\frac{1}{2}$ eq. { Oxygen .... $1\frac{1}{2}$
Potassium . $1\frac{1}{2}$ —— Sulphuret of Potassium 1

{ Held in solution by Potassa.

B.

Before decomposition. After decomposition.

Sulphuric Acid .... Sulphate of Potassa.

The solution.
- Potash ....
- Sesquisulphuret of Antimony .. 5 — Oxysulphuret of Antimony.
- Sesquioxide of Antimony 1
- Sesquisulphuret of Potassium. { Sulphur ... — Hydrosulphuric Acid.
- { Potassium ..

Diluted Sulphuric Acid.
- Hydrogen ....
- Oxygen ....
- Sulphuric Acid .... Sulphate of Potassa.

ANTIMONII POTASSIO-TARTRAS.

Composition.
- 1 Tartrate of Potassa .... = 114
- 1 Ditartrate of Antimony .... = 220
- 3 Water .... = 27

361 Equivalent.

A.

Sesquisulphuret of Antimony.
- Sesquisulphuret of Antimony .... } Oxysulphuret of Antimony.
- Antimony. —— Sesquioxide of Antimony
- Sulphur.

Nitrate of Potassa.
- Nitrogen .... Off
- Oxygen . 3 ....
- Oxygen ....
- Potassa .... Sulphate of Potassa. } Removed by washing.
- Potassa. { Potassium — Chloride of Potassium.
- { Oxygen ...

Hydrochloric Acid. { Chlorine .
{ Hydrogen — Water.

B.

Bitartrate of Potassa, 1 eq.
- Tartrate of Potassa .... 1 .... — Potassio-tartrate of Antimony.
- Tartaric Acid .... 1 — Ditartr. of Antimony.

Oxysulphuret of Antimony.
- Sesquioxide of Antimony 2
- Sesquisulph. of Antimony —————— Not acted upon.

PULVIS ANTIMONIALIS COMPOSITUS.

Composition.
- Antimonious Acid .... = 35 parts.
- Phosphate of Lime .... = 65

100

Atmospheric Oxygen .... 2 — Sulphurous Acid.
Atmospheric Oxygen 2

Sesquisulphuret of Antimony.
- Sulphur ....
- Antimony .... — Antimonious Acid. } Pulv. Antim. comp.

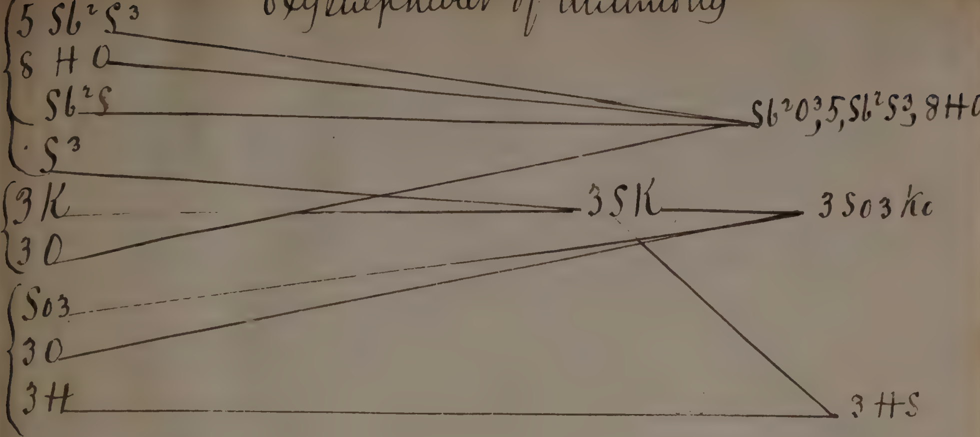
Horn.
- Phosphate of Lime ....
- Gelatine .... —— Dissipated by heat.

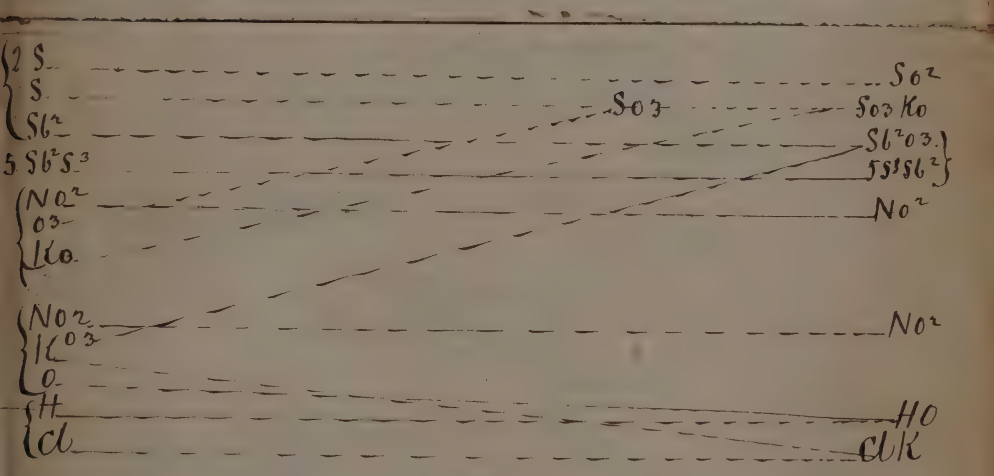
ARGENTI NITRAS.

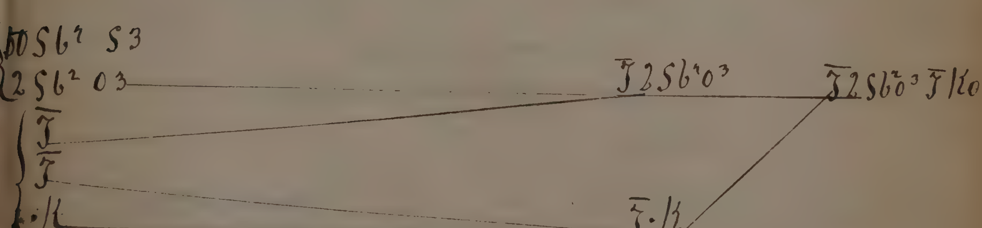
Composition.
- 1 Nitric Acid .... = 54
- 1 Oxide of Silver. = 116

170 Equivalent,

oxysulphuret of antimony







Tests

HS. orange yellow $Sb^2 S^3$

Atmospheric Oxygen .... 2 —————— 1 Nitrous Acid Gas.
Nitric Acid, 4 eqs. { Nitric Acid 1 { Binoxide of Nitrogen 1
Oxygen 3
Nitric Acid 3
Silver .... 3 —————— 3 Nitrate of Silver.

ARGENTI CYANIDUM.

Composition. { 1 Cyanogen = 26
1 Silver .... = 108

134 Equivalent.

Before decomposition. After decomposition.

Nitrate of silver, 1 eq. { Nitric Acid 1 —————— Free.
Oxygen .... 1 —————— 1 Water.
Silver 1
Hydrocyanic Acid, 1 eq. { Hydrogen ... 1
Cyanogen ... 1 —————— 1 Cyanide of Silver.

LIQUOR POTASSÆ ARSENITIS.

Composition of Arsenious Acid. { 2 Arsenicum = 76
3 Oxygen .. = 24

100 Equivalent.

Carbonate of Potassa, 1 eq. { Carbonic Acid 1 ....Off as gas.
Potassa 1
Arsenious Acid .... 1 —————— 1 Arsenite of Potassa.

BARII CHLORIDUM.

Composition. { 1 Chlorine = 36
1 Barium = 68

104 Equivalent.

Carbonate of Baryta, 1 eq. { Carbonic Acid.. 1 ....Off as gas.
Oxygen .... 1 —————— 1 Water.
Barium 1
Hydrochloric Acid, 1 eq. { Hydrogen 1
Chlorine .... 1 —————— 1 Chloride of Barium.

BISMUTHI TRISNITRAS.

Composition. { 1 Nitric Acid ...... = 54
3 Oxide of Bismuth = 240

294 Equivalent.

A.

Before decomposition. After decomposition.

Atmospheric Oxygen .... 2 { 1 Nitrous Acid Gas.
Nitric Acid, 4 eqs. { Nitric Acid 1 { Binoxide of Nitrogen 1
Oxygen 3
Nitric Acid 3
Bismuth .... 3 { 3 Nitrate of Bismuth.

B.

Nitrate of Bismuth, 3 eqs.	Oxide of Bismuth 3	———Trisnitrate of Bismuth (precipitated).
	Nitric Acid 1	
	Nitric Acid 2	
Water		———Unite.

CALX.

Composition. { 1 Oxygen ...... = 8
1 Calcium ..... = 20

28 Equivalent.

Chalk	Carbonic Acid 1	..........Driven off by heat.
	Lime 1	————Remains.

CALCII CHLORIDUM.

Composition. { 1 Chlorine = 36
1 Calcium = 20

56 Equivalent.

Before decomposition.		After decomposition.
Carbonate of Lime, 1 eq.	Carbonic Acid 1............	1 Off as gas.
	Oxygen ...... 1————	1 Water.
	Calcium. 1	
Hydrochloric Acid, 1 eq.	Hydrogen ... 1	
	Chlorine .... 1————	1 Chloride of Calcium.

CALX CHLORINATA.

Composition. { 1 Chlorine .... = 36
2 Hydrate of Lime = 74

110 Equivalent.

Hydrate of Lime	2	1 Chloride of Lime.
Hydrochloric Acid, 2 eqs.	Chlorine .. 1	
	Chlorine .. 1	1 Chloride of Manganese.
	Hydrogen 2	
Binoxide of Manganese, 1 eq.	Manganese 1	
	Oxygen .. 2	2 Water.

CUPRI AMMONIO-SULPHAS.

Composition. { Carbonate of Copper.
Sulphate of Ammonia.
Sesquicarbonate of Ammonia.

Sulphate of Copper.	Oxide of Copper		
	Sulphuric Acid		
Sesquicarbonate of Ammonia.	Carbonic Acid	Carbonate of Copper	
	Carbonic Acid........	....	......Escapes.
	Ammonia	Sulphate of Ammonia	
Sesquicarbonate of Ammonia			Ammonio Sulphate of Copper.

FERRI SULPHAS.

Composition of the Crystals.	1 Sulphuric Acid....	= 40
	1 Protoxide of Iron..	= 36
	7 Water	= 63
		139 Equivalent.

Water, 1 eq.	Hydrogen....	1	.... Off as Gas.
	Oxygen......	1	
Iron		1	
Sulphuric Acid		1	———— 1 Sulphate of Iron.

FERRI SESQUIOXYDUM.

Composition.	3 Oxygen = 24
	2 Iron... = 56
	80 Equivalent.

Before decomposition.			After decomposition.
Carbonate of Soda, 1 eq.	Soda	1	———— 1 Sulphate of Soda.
	Carbonic Acid	1	
Sulphate of Iron, 1 eq.	Sulphuric Acid	1	
	Oxide of Iron	1	———— 1 Carbonate of Iron.

By exposure to the atmosphere while being washed and dried, the carbonate of iron loses its carbonic acid and acquires a larger quantity of oxygen, thus becoming a sesquioxide.

Air.	Nitrogen	Free.
	Oxygen......	Sesquioxide of Iron.
Carbonate of Iron.	Oxyde of Iron	
	Carbonic Acid...........	Free.

TINCTURA FERRI SESQUICHLORIDI.

Composition of Sesquichloride of Iron.	$1\frac{1}{2}$ Chlorine 54
	1 Iron.... 28
	82 Equivalent.

Hydrochloric Acid, 3 eqs.	Hydrogen....	3	———— 3 Water.
	Chlorine....	3	
Sesquioxide of Iron, 1 eq.	Oxygen.......	3	
	Iron.........	2	———— 1 Sesquichloride of Iron.

The Sesquichloride dissolved in rectified spirit, forms the Tinct. Ferri Sesquichloridi.

FERRI POTASSIO-TARTRAS.

Composition.	1 Tartrate of Potassa	114
	1 Tartrate of Sesquioxide of Iron	106
		220 Equivalent.

Before decomposition. After decomposition.

A.

Before decomposition			After decomposition
Sesquioxide of Iron, 1 eq.	Oxygen ..	3	3 Water.
	Iron	2	
Hydrochloric Acid, 3 eqs.	Hydrogen	3	
	Chlorine	3	1 Sesquichloride of Iron.

B.

Before decomposition			After decomposition
Sesquichloride of Iron, 1 eq.	Chlorine..	3	3 Chloride of Potassium.
	Iron.....	2	
Potassa, 3 eqs.	Potassium	3	
	Oxygen ..	3	1 Hydrated Sesquioxide of Iron.

C.

Before decomposition			After decomposition	
Bitartrate of Potassa, 1 eq.	Tartrate of Potassa	1	1 Tartrate of Potassa........	1 Potassio-tartrate of Iron.
	Tartaric Acid	1		
Hydrated Sesquioxide of Iron		1	1 Tartrate of Iron.	

FERRI AMMONIO CHLORIDUM.

Composition.	Sesquichloride of Iron	15 Parts.
	Hydrochlorate of Ammonia	85
		100

Before decomposition			After decomposition	
Hydrochloric Acid, 3 eqs.	Hydrogen	3	3 Water.	
	Chlorine..	3		
Sesquioxide of Iron, 1 eq.	Oxygen ..	3		
	Iron	2	1 Sesquichloride of Iron	Ammonio chloride of Iron.
Hydrochlorate of Ammonia				

FERRI IODIDUM.

Composition.	1 Iodine .... =	126
	1 Iron .... =	28
	5 Water .... =	45
		199 Equivalent.

Iodine ..	1	Iodide of Iron.
Water ..	5	
Iron	1	

HYDRARGYRI BICHLORIDUM.

Composition	2 Chlorine .. =	72
	1 Mercury .. =	202
		274 Equivalent.

A.

Before decomposition			After decomposition
Liquid Sulphuric Acid, 4 eqs.	Water	4	...........Evaporated.
	Sulphurous Acid	2	...........Off as gas.
	Oxygen	2	
	Sulphuric Acid ..	2	
Mercury		1	1 Bi-persulphate of Mercury.

Before decomposition.			After decomposition.
B.			
Bipersulphate of Mercury, 1 eq.	Mercury	1	1 Bichloride of Mercury.
	Sulphuric Acid	2	
	Oxygen	2	
Chloride of Sodium, 2 eqs.	Chlorine	2	
	Sodium	2	2 Sulphate of Soda.

HYDRARGYRI CHLORIDUM.

Composition. 1 Chlorine = 36; 1 Mercury = 202

238 Equivalent.

A.			
Bipersulphate of Mercury, 1 eq.	Mercury	1	1 Proto-sulphate of Mercury.
	Oxygen	1	
	Oxygen	1	
	Sulphuric Acid	1	
	Sulphuric Acid	1	
Mercury		1	1 Proto-sulphate of Mercury.
B.			
Proto-sulphate of Mercury, 2 eqs.	Mercury	2	2 Chloride of Mercury.
	Oxygen	2	
	Sulphuric Acid	2	
Chloride of Sodium, 2 eqs.	Chlorine	2	
	Sodium	2	2 Sulphate of Soda.

HYDRARGYRI AMMONIO-CHLORIDUM.

Composition. 2 Ammonia .... = 34; 1 Binoxide of Mercury = 218; 1 Bichloride of Mercury = 274

526 Equivalent.

Before decomposition.				After decomposition.
Ammonia, 4 eqs.	Ammonia	2		2 Hydrochlorate of Ammonia (poured off).
	Ammonia	2		
Water, 2 eqs.	Hydrogen	2	2 Hydrochloric Acid	
	Oxygen ..	2		
Bichloride of Mercury, 2 eqs.	Chlorine .	2	2 Ammonia	Ammonio chloride of Mercury.
	Mercury .	1	1 Binoxide of Mercury	
	Bichloride of Mercury		1	

HYDRARGYRI OXYDUM.

Composition. 1 Oxygen = 8; 1 Mercury .. 202

210 Equivalent.

Lime, 1 eq.	Calcium ...	1	1 Chloride of Calcium.
	Oxygen ...	1	
Chloride of Mercury, 1 eq.	Chlorine ..	1	
	Mercury ..	1	1 Oxyde of Mercury.

HYDRARGYRI BINOXYDUM.

Composition. { 2 Oxygen.. = 16
{ 1 Mercury . = 202

218 Equivalent.

Before decomposition.			After decomposition.
Potassa, 2 eqs.	Potassium	2	2 Chloride of Potassium.
	Oxygen ..	2	
Bichloride of Mercury, 1 eq.	Chlorine..	2	
	Mercury..	1	1 Binoxide of Mercury.

HYDRARGYRI NITRICO-OXYDUM.

A.

Atmospheric Oxygen			2	1 Nitrous Acid gas
Nitric Acid, 4 eqs.	Nitric Acid 1	Binoxide Nitrogen	1	
		Oxygen	3	
	Nitric Acid		3	
Mercury			3	3 Proto-nitrate of Mercury.

B.

Atmospheric Oxygen			Nitrous Acid gas.
Proto-nitrate of Mercury.	Nitric Acid	Binoxide Nitrogen	
		Oxygen	
	Oxide of Mercury		Binoxide of Mercury.

HYDRARGYRI BICYANIDUM.

Composition. { 2 Cyanogen = 52
{ 1 Mercury . = 202

254 Equivalent.

Percyanide of Iron.	Iron	Oxide of Iron.
	Cyanogen....	
Binoxide of Mercury.	Oxygen......	
	Mercury	Bicyanide of Mercury.

Before decomposition. After decomposition.

SECOND PROCESS.

Hydrocyanic Acid, 2 eqs.	Hydrogen	2	2 Water.
	Cyanogen	2	
Binoxide of Mercury, 1 eq.	Oxygen	2	
	Mercury......	1	1 Bicyanide of Mercury.

HYDRARGYRI IODIDUM.

Composition. { 1 Iodine.. = 126
{ 1 Mercury = 202

328 Equivalent.

Iodine......	1	1 Iodide of Mercury.
Mercury....	1	

HYDRARGYRI BINIODIDUM.

Composition. { 2 Iodine.. = 252
1 Mercury = 202

454 Equivalent.

Iodine...... 2
Mercury.... 1 — 1 Biniodide of Mercury.

MAGNESIA.

Composition. { 1 Oxygen ... = 8
1 Magnesium = 12

20 Equivalent.

Before decomposition.			After decomposition.
Carbonate of Magnesia	Carbonic Acid	———	Driven off by heat.
	Magnesia....	———	Remains.

MAGNESIÆ CARBONAS.

Composition. { 1 Carbonic Acid = 22
1 Magnesia..... = 20

42 Equivalent.

Carbonate of Soda, 1 eq.	Soda	1	———	1 Sulphate of Soda.
	Carbonic Acid....	1		
Sulphate of Magnesia, 1 eq.	Sulphuric Acid....	1		
	Magnesia	1	———	1 Carbonate of Magnesia.

PLUMBI ACETAS.

Composition. { 1 Acetic Acid ... = 51
1 Oxide of Lead = 112
3 Water ...... = 27

190 Equivalent.

Acetic Acid 1
Water.................... 3 — Acetate of Lead.
Oxide of Lead............ 1

LIQUOR PLUMBI DIACETATIS.

Composition. { 1 Acetic Acid ... = 51
2 Oxide of Lead = 224

275 Equivalent.

Before decomposition.			After decomposition.
Acetate of Lead, 1 eq.	Acetic Acid	1	
	Oxide of Lead	1	1 Diacetate of Lead.
Oxide of Lead	....	1	

PLUMBI CHLORIDUM.

Composition.		
	1 Chlorine =	36
	1 Lead ... =	104
		140 Equivalent.

Chloride of Sodium, 1 eq.	Sodium	1	1 Acetate of Soda.
	Chlorine	1	
Acetate of Lead, 1 eq.	Acetic Acid....	1	
	Oxygen	1	
	Lead	1	1 Chloride of Lead.

PLUMBI IODIDUM.

Composition.		
	1 Iodine =	126
	1 Lead . =	104
		230 Equivalent.

Before decomposition.			After decomposition.
Iodide of Potassium, 1 eq.	Potassium	1	1 Acetate of Potassa.
	Iodine	1	
Acetate of Lead, 1 eq.	Acetic Acid....	1	
	Oxygen	1	
	Lead	1	1 Iodide of Lead.

PLUMBI OXYDUM HYDRATUM.

Composition.	
	Protoxide of Lead.
	Water, (proportion unknown).

Solution of Potassa.	Potassa	Acetate of Potassa.
	Water	
Diacetate of Lead.	Acetic Acid ..	
	Oxide of Lead	Hydrated oxide of Lead.

POTASSÆ CARBONAS.

Composition.			
	1	Carbonic Acid	22
	1	Potassa	48
	$1\frac{1}{2}$	Water	12
			82 Equivalent.

Impure Carbonate of Potassa.	Sulphate of Potassa and Chloride of Potassium, left.	
	Carbonate of Potassa.	
Distilled Water		Pure Carbonate of Potassa.

POTASSÆ BICARBONAS.

Composition.		
	2 Carbonic Acid =	44
	1 Potassa ...... =	48
	1 Water ...... =	9
		101 Equivalent.

Carbonate of Potassa ...... 1 ———— 1 Bicarbonate of Potassa.
Carbonate of Lime, 1 eq. { Carbonic Acid 1
{ Lime........ 1
Sulphuric Acid .... 1 ———— 1 Sulphate of Lime.

LIQUOR POTASSÆ.

Solution of Carbonate of Potassa. { Water ...... ———— Liquor Potassæ.
{ Potassa ......
{ Carbonic Acid
Lime .... ———— Carbonate of Lime.

POTASSÆ HYDRAS.

Composition. { 1 Potassa = 48
{ 1 Water. = 9

57 Equivalent.

Solution of Potassa. { Potassa.... 1 ———— Hydrate of Potassa.
{ Water 1
{ Water .... ———— Expelled by heat.

POTASSÆ ACETAS.

Composition. { 1 Acetic Acid = 51
{ 1 Potassa .... = 48

99 Equivalent.

Carbonate of Potassa, 1 eq. { Carbonic Acid..... 1 .... Off as gas.
{ Potassa 1
Acetic Acid .... 1 ———— 1 Acetate of Potassa.

POTASSÆ SULPHAS.

Composition. { 1 Sulphuric Acid = 40
{ 1 Potassa ...... = 48

88 Equivalent.

Bi-sulphate of Potassa. { Sulphuric Acid .... 1 ———— Driven off by heat.
{ Sulphate of Potassa 1 ———— Remains.

POTASSÆ TARTRAS.

Composition. { 1 Tartaric Acid = 66
{ 1 Potassa ...... = 48

114 Equivalent.

Carbonate of Potassa, 1 eq. { Carbonic Acid ..... 1 .... Off as gas.
{ Potassa 1
Bitartrate of Potassa, 1 eq. { Tartaric Acid ...... 1 1 Tartrate of Potassa.
{ Tartrate of Potassa 1 ———— 1 Tartrate of Potassa.

POTASSII BROMIDUM.

Composition. { 1 Bromine . = 78
1 Potassium = 40

118 Equivalent.

Bromide of Iron, 1 eq. { Bromine ..... 1 —— 1 Bromide of Potassium.
Iron 1
Carbonate of Potassa, 1 eq. { Potassium 1
Oxygen 1
Carbonic Acid 1 —— 1 Carbonate of Iron.

POTASSII IODIDUM.

Composition. { 1 Iodine ....= 126
1 Potassium = 40

166 Equivalent.

Iodide of Iron, 1 eq. { Iodine ...... 1 —— 1 Iodide of Potassium.
Iron 1
Carbonate of Potassa, 1 eq. { Potassium 1
Oxygen 1
Carbonic Acid 1 —— 1 Carbonate of Iron.

POTASSII SULPHURETUM.

Composition. { 3 Sulphuret of Potassium = 168
1 Sulphate of Potassa. ... = 88

256 Equivalent.

Sulphur, 4 eqs. { Sulphur...... 1 —— 1 Sulphate of Potassa.
Sulphur...... 3
Carbonate of Potassa, 4 eqs. { Potassa...... 1
Oxygen...... 3
Potassium.... 3 —— 3 Sulphuret of Potassium.
Carbonic Acid 4............Off as gas.

SODÆ CARBONAS.

Composition of the crystals. { 1 Carbonic Acid = 22
1 Soda......... = 32
10 Water....... = 90

144 Equivalent.

Impure Carbonate of Soda. { Impurities.
Carbonate of Soda.
Distilled Water..................... Pure Carbonate of Soda in solution.

SODÆ CARBONAS EXSICCATA.

Composition. { 1 Carbonic Acid = 22
1 Soda .... = 32

54 Equivalents.

Carbonate of Soda.	Water	Expelled by heat.
	Carbonate of Soda	Dry Carbonate of Soda.

SODÆ SESQUICARBONAS.

Composition.	$1\frac{1}{2}$	Carbonic Acid	= 33
	1	Soda	= 32
	2	Water	= 18
			83 Equivalent.

Carbonate of Soda, 1 eq.	Soda..............	1	1 Sesquicarbonate of Soda.
	Carbonic Acid....	1	
Carbonic Acid..................		$\frac{1}{2}$	

SODÆ SULPHAS.

Composition of the Crystals.	1	Sulphuric Acid =	40
	1	Soda .... =	32
	10	Water........ =	90
			162 Equivalent.

Carbonate of Soda.	Carbonic Acid..	Off as gas.
	Soda	Sulphate of Soda.
Super-sulphate of Soda.	Sulphuric Acid..	Sulphate of Soda.
	Sulphate of Soda	Sulphate of Soda.

SODÆ POTASSIO-TARTRAS.

Composition.	1	Tartrate of Potassa =	114
	1	Tartrate of Soda.. =	98
	8	Water .... =	72
			284 Equivalent.

Before decomposition.			After decomposition.
Carbonate of Soda, 1 eq.	Carbonic Acid.....	1	Off as gas.
	Soda	1	1 Potassio-Tartrate of Soda.
Bitartrate of Potassa, 1 eq.	Tartaric Acid.....	1	
	Tartrate of Potassa.	1	

LIQUOR SODÆ CHLORINATÆ.

Solution of Carbonate of Soda..............			Liquor Sodæ Chlorinatæ.
Chloride of Sodium, 1 eq.	Chlorine............	1	
	Sodium	1	
Binoxide of Manganese, 1 eq.	Oxygen..............	1	
	Protoxide Manganese.	1	
Sulphuric Acid		1	1 Sulphate of Soda.
Sulphuric Acid		1	1 Sulphate of Manganese.

ZINCI SULPHAS.

Composition.	1	Sulphuric Acid =	40
	1	Oxide of Zinc.. =	40
	7	Water........ =	63
			143 Equivalent.

Before decomposition. After decomposition.

Water, 1 eq. { Hydrogen 1............Off as gas.
{ Oxygen.. 1
Zinc.................. 1
Sulphuric Acid. .... 1——————1 Sulphate of Zinc.

ZINCI OXYDUM.

Composition. { 1 Zinc.... 32
{ 1 Oxygen . 8

40 Equivalent.

A.
Sesquicarbonate of Ammonia. { Ammonia..........——————Sulphate of Ammonia.
{ Carbonic Acid.....
Sulphate of Zinc. { Sulphuric Acid.....
{ Oxide of Zinc......——————Carbonate of Zinc.

B.
Carbonate of Zinc. { Carbonic Acid ....Expelled by heat.
{ Oxide of Zinc. ......——————Remains.

ACETOUS FERMENTATION.

When alcohol, mixed with yeast, is exposed to the air in a warm temperature, the following changes take place.

Before decomposition. After decomposition.

Alcohol, 2 eqs. { Oxygen........ 2——————1 Acetic Acid.
{ Carbon......... 4
{ Hydrogen...... 3
{ Hydrogen....... 3
Atmospheric Oxygen, 4 eqs. { Oxygen........ 1
{ Oxygen........ 3——————3 Water.

VINOUS FERMENTATION.

When sugar, dissolved in water, and mixed with a little yeast, is placed in a temperature of about 70°, the following decomposition occurs.

Composition of Sugar. { 1 Carbon. .. = 6
{ 1 Oxygen.. = 8
{ 1 Hydrogen = 1

15 Equivalent.

Composition of Alcohol. { 2 Carbon... = 12
{ 1 Oxygen.. = 8
{ 3 Hydrogen = 3

23 Equivalent.

Before decomposition.			After decomposition.
Sugar, 3 eqs.	Carbon..........	1	1 Carbonic Acid.
	Carbon..........	2	
	Oxygen..........	2	
	Oxygen..........	1	
	Hydrogen........	3	1 Alcohol.

PUTREFACTIVE FERMENTATION.

The composition of vegetable bodies is chiefly carbon, oxygen, and hydrogen. The results of their decomposition are as follow :—

Carbonic Acid——Oxygen..——Water.
Carbon...
Vinegar.....——Hydrogen——Carburetted Hydrogen.

Animal matter consists principally of carbon, oxygen, hydrogen, sulphur, and phosphorus: the results of decomposition are shown in the following diagram.

Animal Matter.	Carbon. ...	Carbonic Oxide.
	Carbon. ...	
	Oxygen ...	
	Oxygen ...	Carbonic Acid.
	Oxygen ...	Water.
	Nitrogen. .	
	Hydrogen .	
	Hydrogen .	Ammonia.
	Hydrogen .	Sulphuretted Hydrogen.
	Hydrogen .	
	Sulphur. .	
	Phosphorus	Phosphuretted Hydrogen.

PREPARATION OF ALUM.

(Sulphas Aluminæ et Potassæ.)

Composition of Alumina.	1 Aluminum........	= 10
	1 Oxygen...........	= 8
		18 Equivalent.

Composition of Alum.	3 Sulphate of Alumina	= 174
	1 Sulphate of Potassa .	= 88
	25 Water............	= 225
		487 Equivalent.

Alum-slate contains sulphuret of iron, alumina, and potassa; when roasted, the iron and sulphur unite with the oxygen of the atmosphere, and form oxide of iron and sulphuric acid; the latter combines with

the alumina and potassa to form alum, which is dissolved out by water, still, however, retaining a little oxide of iron. These changes are illustrated below.

Atmospheric Oxygen ....———————————Oxide of Iron.
Atmospheric Oxygen ....
Alum-slate. { Sulphuret of Iron. { Iron. .. / Sulphur————————Sulphuric Acid
Alumina ....
Potassa ....————————Alum.

Frequently the alum-slate does not contain sufficient potassa; in this case a salt of potassa, either chloride of potassium, or sulphate of potassa, is added.

PREPARATION OF FERROCYANIDE OF POTASSIUM.

When animal matter is heated with potassa in an iron retort, the carbon and nitrogen of the former unite to form cyanogen, which, combining with the potassium of the potassa and the iron of the retort, constitutes ferrocyanide of potassium. It is purified by solution and crystallization.

Composition of Cyanogen.	2 Carbon	= 12
	1 Nitrogen	= 14
		26 Equivalent.

Composition of Ferrocyanide of Potassium.	2 Cyanide of Potassium	= 132
	1 Cyanide of Iron.	= 54
	3 Water..............	= 27
		213 Equivalent.

Animal Matter. { Hydrogen. ———————— Expelled by heat.
Oxygen . .
Nitrogen .
Carbon .. ———Cyanogen

Potassa......... { Oxygen ..
Potassium

The Retort .... Iron. ....————————————Ferrocyanide of Potassium.

PREPARATION OF IODINE.

Equivalent, 126.

Kelp, the impure carbonate of soda, obtained by incinerating sea-weeds, contains a quantity of iodine, in combination with sodium or potassium. After the carbonate of soda has been removed by solution and crystallization, a dark coloured fluid remains, termed "Mother liquor," containing iodide of sodium or potassium. To this liquor sulphuric acid and peroxide of manganese are added, sulphates of soda and manganese

formed, and by the aid of heat, the iodine is sublimed. The process is illustrated below.

Mother Liquor contains	Iodine	1	Sublimes.
	Sodium	1	
Peroxide of Manganese.	Oxygen	1	
	Protoxide of Manganese	1	
Sulphuric Acid		1	Sulphate of Soda.
Sulphuric Acid		1	Sulphate of Manganese.

PREPARATION OF HYDRIODIC ACID.

Composition. $\left\{\begin{array}{l}1 \text{ Hydrogen} = 1 \\ 1 \text{ Iodine....} = 126\end{array}\right.$

127 Equivalent.

When periodide of phosphorus is put into water, and a gentle heat applied, the following decomposition ensues.

Periodide of Phosphorus.	Iodine	5	5 Hydriodic Acid.
	Phosphorus	2	
Water	Hydrogen	5	
	Oxygen	5	1 Phosphoric Acid.

PREPARATION OF BROMINE.

Equivalent, 78.

Bromine exists in sea-water combined with sodium or magnesium; when chloride of sodium has been removed by crystallization, a brown coloured liquid of an acrid odour remains, named "bittern," which contains bromide of magnesium. Sulphuric acid and peroxide of manganese are added to the bittern, and the results are as follow:

Bittern contains	Bromine	1	Sublimes.
	Magnesium	1	
Peroxide of Manganese.	Oxygen	1	
	Protoxide of Manganese	1	
Sulphuric Acid		1	1 Sulphate of Magnesia.
Sulphuric Acid		1	1 Sulphate of Manganese.

Hydrobromic acid may be obtained by applying a gentle heat to the perbromide of phosphorus dissolved in water. The following diagram shows the decomposition:

Perbromide of Phosphorus, 1 eq.	Bromine....	5	5 Hydrobromic Acid.
	Phosphorus	2	
Water, 5 eqs.	Hydrogen..	5	
	Oxygen....	5	1 Phosphoric Acid.

PREPARATION OF NITRO-HYDROBROMIC ACID.

Composition. { Bromine. Water. Nitrous Acid.

When hydrobromic acid and nitric acid are mixed together the following changes take place:

Hydrobromic Acid, 1 eq.	Bromine	1——————1	Bromine.
	Hydrogen ...	1	
Nitric Acid, 1 eq.	Oxygen	1——————1	Water.
	Nitrous Acid	1——————1	Nitrous Acid.

The nitro-hydrobromic acid which is formed possesses the power of dissolving gold on account of the free bromine.

PREPARATION OF BROMATE OF BARYTA.

Composition. { 1 Bromic Acid = 118
1 Baryta ...... = 76

194 Equivalent.

When bromine is added to a solution of any of the alkalies or alkaline earths the following decomposition takes place:

Baryta, 6 eqs.	Barium	5——————5	Bromide of Barium.
	Oxygen	5	
	Baryta	1	
Bromine, 6 eqs.	Bromine	5	
	Bromine	1——————1	Bromate of Baryta.

The bromate can be easily separated from the bromide by evaporation and crystallization.

PREPARATION OF BROMIC ACID.

Composition. { 1 Bromine = 78
5 Oxygen = 40

118 Equivalent.

Solution of Bromate of Baryta.	Water ....——————	Bromic Acid in solution.
	Bromic Acid	
	Baryta...........	
Sulphuric Acid................——————		Sulphate of Baryta.

PREPARATION OF HYDROCHLORATE OF AMMONIA.

When impure coal gas is passed through water, a large quantity of ammonia contained in the gas is absorbed; to this solution sulphuric acid is added, and sulphate of ammonia formed, thus fixing the volatile alkali. Chloride of sodium is then mixed with the crystallized sul-

phate, and heat being applied, hydrochlorate of ammonia sublimes and sulphate of soda remains. The following diagram illustrates the process:

Composition.	1 Ammonia	= 17
	1 Hydrochloric Acid ..	= 37
		54 Equivalent.

Sulphate of Ammonia.	Ammonia	Hydrochlorate of Ammonia (sublimed).
	Sulphuric Acid ..	
Water.	Hydrogen	
	Oxygen	
Chloride of Sodium.	Chlorine	
	Sodium	Sulphate of Soda.

PREPARATION OF SULPHURIC ACID.

Sulphur, mixed with an eighth part of its weight of nitrate of potassa, is burned in such a position that the gaseous products of combustion are carried by a current of air into a chamber lined with lead, and having its floor covered with a stratum of water several inches deep. The nitrate of potassa is decomposed, the nitric acid yields part of its oxygen to a little sulphur, forming sulphuric acid, which with the potassa forms a sulphate; the greater portion of the sulphur, however, unites with atmospheric oxygen and is converted into sulphurous acid. The nitric acid, having lost part of its oxygen, is changed into binoxide of nitrogen, which immediately combining with oxygen of the air forms nitrous acid, and, together with the sulphurous acid, passes into the chamber. The watery vapour present in the chamber, coming into contact with the nitrous and sulphurous acids, causes an immediate change in their composition, and a crystalline compound results, consisting of sulphuric acid, hyponitrous acid, and water. This crystalline substance, in consequence of its specific gravity, falls into the water, and decomposition again ensues. The sulphuric acid is retained in solution, while the hyponitrous acid is converted into nitrous acid and binoxide of nitrogen, which escape with effervescence. The binoxide meeting with more atmospheric oxygen, is instantly changed into nitrous acid, and enters into the composition of a further portion of crystalline matter, which is again precipitated and decomposed. These changes are continually repeated until the water is made very acid, when it is drawn off and concentrated by boiling in platinum vessels. The following diagrams are intended to illustrate the several changes which occur:

Composition of dry Sulphuric Acid.	3 Oxygen	= 24
	1 Sulphur	= 16
		40 Equivalent.

Composition of Aqueous Sulphuric Acid. { 1 Sulphuric Acid = 40
1 Water........ = 9

49 Equivalent.

CHANGES WHICH TAKE PLACE WITHOUT THE CHAMBER.

Atmospheric Oxygen ....——→Nitrous Acid.
Nitrate of Potassa. { Binoxide of Nitrogen ..
Oxygen..............
Potassa..............——→Sulphate of Potassa.
Sulphur........................
Sulphur........................
Atmospheric Oxygen ....——→Sulphurous Acid.

CHANGES WHICH TAKE PLACE WITHIN THE CHAMBER.

B.

Nitrous Acid, 2 eqs. { Hyponitrous Acid 2——2 Hyponitrous Acid. } Crystalline compound.
Oxygen......... 2
Sulphurous Acid .... 2——→2 Sulphuric Acid. } Crystalline compound.
Water ....——Water. } Crystalline compound.

C.

Crystalline compound. {
Hyponitrous Acid, 2 eqs. { Nitrogen 1——{ Binoxide of Nitrogen, which again forms Nitrous Acid.
Nitrogen 1
Oxygen . 2
Oxygen . 4——Nitrous acid.
Sulphuric Acid......... 2
Water ....——Retained by the water on the floor.

PREPARATION OF PHOSPHORUS.

Equivalent, 16.

Sulphuric acid is added to the well burnt ashes of bone, and sulphate and superphosphate of lime are formed. The latter being the more soluble salt, is dissolved out by water, and the solution having been evaporated to the consistence of syrup, is mixed with charcoal. By the assistance of heat the oxygen is removed from the excess of phosphoric acid in the form of carbonic oxide and carbonic acid, phosphorus distils, and phosphate of lime remains in the retort.

A.

Bone ashes. { Phosphoric Acid ....——Superphosphate of Lime.
Lime...............
Sulphuric Acid ....——Sulphate of Lime.

B.

Carbon.............................——Carbonic Oxide and Acid.
Superphosphate of Lime. { Phosphoric Acid. { Oxygen ....
Phosphorus .——Distils over.
Phosphate of Lime ......——Remains in the retort.

DIAGRAM SHOWING THE DECOMPOSITION OF WATER BY ELECTRICITY.

Composition of Water. { 1 Hydrogen = 1; 1 Oxygen .. = 8

9 Equivalent.

Water.	Hydrogen........ 2 vols.	————	Hydrogen 2 vols.
	Oxygen.......... 1 vol.		
Electricity.	Negative Pole		
	Positive Pole.....	————	Oxygen 1 vol.

PREPARATION OF OXYGEN.

Equivalent 8. Specific gravity 1.1026.

Oxygen may be procured from chlorate of potassa, binoxide of manganese, and binoxide of mercury, by the application of heat.

DECOMPOSITION OF CHLORATE OF POTASSA.

Chlorate of Potassa.	Chloric Acid.	Oxygen 5	————	6 Oxygen given off.
		Chlorine 1		
	Potassa.	Oxygen 1		
		Potassium .. 1	————	1 Chloride of Potassium.

DECOMPOSITION OF BINOXIDE OF MANGANESE.

Binoxide of Manganese, 2 eqs.	Oxygen 1	————	1 Oxygen given off.
	Oxygen 3		
	Manganese... 2	————	1 Sesquioxide of Manganese.

DECOMPOSITION OF BINOXIDE OF MERCURY.

Binoxide of Mercury, 1 eq.	Oxygen 2	————	2 Oxygen given off.
	Mercury 1	————	1 Mercury, remains.

DECOMPOSITION OF BINOXIDE OF MANGANESE BY SULPHURIC ACID.

Binoxide of Manganese, 1 eq.	Oxygen 1	————	1 Oxygen given off.
	Protoxide of Manganese 1		
Sulphuric Acid	 1	————	1 Sulphate of Protoxide of Manganese.

PREPARATION OF HYDROGEN.

Equivalent 1. Specific gravity ·069.

DECOMPOSITION OF THE VAPOUR OF WATER BY RED HOT IRON.

Vapour of Water.	Hydrogen.. 1	————	1 Hydrogen given off.
	Oxygen.... 1		
Iron	 1	————	1 Oxide of Iron.

DECOMPOSITION OF WATER BY ZINC AND SULPHURIC ACID.

Water.	Hydrogen.. 1	————	1 Hydrogen.
	Oxygen.... 1		
Zinc	 1		
Sulphuric Acid	 1	————	1 Sulphate of Zinc.

The same changes occur when iron is employed instead of zinc.

PREPARATION OF NITROGEN.

Equivalent 14. Specific gravity 0·9727.

Nitrogen is preparéd by burning phosphorus in a jar containing atmospheric air inverted over water, thus—

Atmospheric Air. { Nitrogen ———— —— { Nitrogen, set free, containing carbonic Acid derived from the Air.
Oxygen.
Phosphorus ....———————Metaphosphoric Acid absorbed by the water.

PREPARATION OF PROTOXIDE OF NITROGEN.

Composition. { 1 Nitrogen = 14
1 Oxygen = 8

22 Equivalent.

DECOMPOSITION OF NITRATE OF AMMONIA BY HEAT.

Nitrate of Ammonia, 1 eq. {
Nitric Acid, 1 eq. { Nitrogen .. 1 — 1 Protoxide of Nitrogen.
Oxygen 1
Oxygen .... 1 — 1 Protoxide of Nitrogen.
Oxygen 3
Ammonia, 1 eq. { Nitrogen .. 1
Hydrogen .. 3 — 3 Water.

PREPARATION OF BINOXIDE OF NITROGEN.

Nitric Acid, 4 eqs. {
Nitric Acid, 1 eq. { Nitrogen.. 1 — 1 Binoxide of Nitrogen.
Oxygen ... 2
Oxygen ... 3
Nitric Acid 3
Copper.............................. 3 — 3 Nitrate of Copper.

PREPARATION OF NITROUS ACID.

Composition. { 1 Nitrogen = 14
4 Oxygen = 32

46 Equivalent.

Atmospheric Oxygen............. 2
Binoxide of Nitrogen............. 1 — 1 Nitrous Acid.

This acid may also be obtained in the liquid form by applying heat to the dry nitrate of lead, and condensing the vapours by a freezing mixture.

Dry Nitrate of Lead. { Nitric Acid { Nitrous Acid————————Nitrous Acid.
Oxygen ....———————Oxygen free.
Oxide of Lead...........———————Oxide of Lead remains.

PREPARATION OF AMMONIACAL GAS.

Composition. { 1 Nitrogen = 14
3 Hydrogen = 3

17 Equivalent.

When a gentle heat is applied to liquor ammoniæ, ammoniacal gas is disengaged, to be collected over mercury.

When a mixture of oxygen and ammoniacal gas is fired, the decomposition ensues expressed in the following diagram.

Ammoniacal Gas.	Nitrogen 1	1 Nitrogen free.
	Hydrogen 3	
Oxygen	3	3 Water.

Ammoniacal gas can also be decomposed by passing chlorine through it.

Ammoniacal Gas.	Nitrogen 1	1 Nitrogen free.
	Hydrogen 3	
Chlorine	3	3 Hydrochloric Acid.

PREPARATION OF CYANOGEN.

Composition.	1 Nitrogen	= 14
	2 Carbon..	= 12
		26 Equivalent.

Bicyanide of Mercury, 1 eq.	Cyanogen 2	Cyanogen driven off by heat.
	Mercury 1	Remains.

PREPARATION OF SULPHURETTED HYDROGEN, OR HYDROSULPHURIC ACID.

Composition.	1 Sulphur..	= 16
	1 Hydrogen	= 1
		17 Equivalent.

It is procured by heating sesquisulphuret of antimony in a glass vessel with hydrochloric acid. The following diagram illustrates the decomposition.

Sesquisulphuret of Antimony, 1 eq.	Sulphur.. 3	3 Sulphuretted Hydrogen.
	Antimony 2	
HydrochloricAcid, 3 eqs.	Hydrogen 3	
	Chlorine . 3	1 Sesquichloride of Antimony.

It may also be prepared by the action of diluted sulphuric acid on protosulphuret of iron. The reaction is shewn below.

Water, 1 eq.	Hydrogen .. 1	1 Sulphuretted Hydrogen.
	Oxygen 1	
Protosulphuret of Iron, 1 eq.	Sulphur ... 1	
	Iron 1	
Sulphuric Acid	1	1 Sulphate of Protoxide of Iron.

COMBUSTION OF SULPHURETTED HYDROGEN.

Sulphuretted Hydrogen, 1 eq.	Hydrogen.. 1	1 Water.
	Sulphur ... 1	
Atmospheric Oxygen, 3 eqs.	Oxygen.... 1	
	Oxygen.... 2	1 Sulphurous Acid.

Sulphuretted hydrogen is decomposed by chlorine, iodine, and bromine, with the formation of hydrochloric, hydriodic, and hydrobromic acids, sulphur being precipitated.

Chlorine		1 ————	1 Hydrochloric Acid.
Sulphuretted Hydrogen, 1 eq.	Hydrogen..	1	
	Sulphur....	1 ————	1 Sulphur precipitated.

Sulphuretted hydrogen decomposes the salts of the following metals:—

Antimony.	Columbium.	Molybdenum.	Tellurium.
Arsenicum.	Copper.	Osmium.	Tin.
Bismuth.	Gold.	Palladium.	Titanium.
Cadmium.	Iridium.	Platinum.	Tungsten.
Cerium.	Lead.	Rhodium.	Vanadium.
Chromium.	Mercury.	Silver.	Zinc.

The following diagram, showing the decomposition of acetate of lead by sulphuretted hydrogen, may serve as an example.

Acetate of Lead, 1 eq.	Acetic Acid		1 ————	1 Acetic Acid free.
	Oxide of Lead.	Oxygen..	1 ————	1 Water.
		Lead	1	
Sulphuretted Hydrogen, 1 eq.	Hydrogen		1	
	Sulphur		1 ————	1 Sulphuret of Lead.

Salts of the metals named below are not decomposed by sulphuretted hydrogen.

Aluminum.	Iron.	Nickel.	Thorinum.
Barium.	Lithium.	Potassium.	Uranium.
Calcium.	Magnesium.	Sodium.	Yttrium.
Cobalt.	Manganese.	Strontium.	Zirconium.
Glucinum.			

But the salts of cobalt, iron, manganese, nickel, and uranium, are precipitated by sulphuret of potassium.

HYDROFLUORIC ACID

Is obtained by mixing sulphuric acid and fluoride of calcium in a leaden retort, and applying a gentle heat.

Fluoride of Calcium, 1 eq.	Fluorine....	1 ————	1 Hydrofluoric Acid.
	Calcium	1	
Water, 1 eq. ..	Hydrogen ..	1	
	Oxygen	1	
Dry Sulphuric Acid		1 ————	1 Sulphate of Lime.

PREPARATION OF CHLORINE.

Equivalent 36.

Chlorine may be obtained by the action of sulphuric acid on binoxide of manganese and chloride of sodium; and also by the action of hydrochloric acid on binoxide of manganese.

PROCESS FIRST.

Chloride of Sodium, 1 eq.	Chlorine	1	1 Chlorine disengaged.
	Sodium	1	
Binoxide of Manganese, 1 eq.	Oxygen	1	
	Protoxide of Manganese	1	
Sulphuric Acid		1	1 Sulphate of Soda.
Sulphuric Acid		1	1 Sulphate of Manganese.

PROCESS SECOND.

Hydrochloric Acid, 2 eqs.	Chlorine	1	1 Chlorine disengaged.
	Chlorine	1	
	Hydrogen	2	
Binoxide of Manganese, 1 eq.	Manganese	1	1 Chloride of Manganese.
	Oxygen	2	2 Water.

ACTION OF HYDROCHLORIC ACID ON A METAL.

Hydrochloric Acid, 1 eq.	Hydrogen	1	1 Hydrogen disengaged.
	Chlorine	1	
Zinc		1	1 Chloride of Zinc.

ACTION OF HYDROCHLORIC ACID ON A METALLIC OXIDE.

Hydrochloric Acid, 1 eq.	Hydrogen	1	1 Water.
	Chlorine	1	
Oxide of Zinc, 1 eq.	Oxygen	1	
	Zinc	1	1 Chloride of Zinc.

PREPARATION OF CARBONIC ACID.

Composition. 1 Carbon = 6
2 Oxygen = 16

22 Equivalent.

Carbonate of Lime.	Carbonic Acid	Carbonic Acid disengaged.
	Oxygen	Water.
	Calcium	
Hydrochloric Acid.	Hydrogen	
	Chlorine	Chloride of Calcium.

PREPARATION OF CARBONIC OXIDE.

Composition. 1 Carbon = 6
1 Oxygen = 8

14 Equivalent.

Carbonic oxide may be prepared by passing carbonic acid over red hot charcoal or iron filings, or by mixing sulphuric and oxalic acids and applying a gentle heat; the annexed diagrams illustrate the decompositions.

PROCESS FIRST.

Carbonic Acid, 1 eq.	Carbon	1	1 Carbonic Oxide.
	Oxygen	1	
	Oxygen	1	
Carbon		1	1 Carbonic Oxide.

PROCESS SECOND.

Carbonic Acid, 1 eq.	Carbon ..	1	1 Carbonic Oxide.
	Oxygen ..	1	
	Oxygen ..	1	
Carbon.....................		1	1 Protoxide of Iron.

PROCESS THIRD.

Oxalic Acid........	Carbon ..	1	1 Carbonic Acid off.
	Carbon ..	1	
	Oxygen ..	2	
	Oxygen ..	1	1 Carbonic Oxide off.
	Water ..	3	
Sulphuric Acid................		1	Left in the retort.

The carbonic acid formed in the last process is removed by agitating the gases with lime water.

PREPARATION OF CHLORATE OF POTASSA.

Chlorine.	Chlorine....	1	1 Chlorate of Potassa.
	Chlorine....	5	
Potassa..	Potassa	1	
	Oxygen	5	
	Potassium ..	5	5 Chloride of Potassium.

The chlorate is easily separated by evaporation and crystallization.

When sulphuret of potassium is put into water, the following changes take place.

Sulphuret of Potassium, 1 eq.	Sulphur....	1	1 Hydrosulphuric Acid.
	Potassium..	1	
Water, 1 eq.	Hydrogen..	1	
	Oxygen....	1	1 Potassa.

PREPARATION OF POTASSIUM.

When two equivalents of charcoal and one equivalent of carbonate of potassa are heated in an iron bottle, the following decomposition takes place.

Carbonate of Potassa, 1 eq.	Potassa	Potassium..	1	1 Potassium.
		Oxygen	1	1 Carbonic Oxide.
	Carbonic Acid	Carbon	1	
		Oxygen	2	
Carbon			2	2 Carbonic Oxide.

When potassium is placed on water, the latter is decomposed, its oxygen combining with a portion of potassium forms potassa, while its hydrogen, with another portion of potassium, forms potassiuretted hydrogen, which, inflaming as it escapes, is resolved into potassa and water.

Potassium ...	Potassium......	Potassiuretted Hydrogen.
	Potassium......	
Water	Hydrogen	
	Oxygen........	Potassa.

COMBUSTION OF POTASSIURETTED HYDROGEN.

Potassiuretted Hydrogen.	Hydrogen	—— Water.
	Potassium	
Atmospheric Oxygen.	Oxygen..	
	Oxygen..	—— Potassa.

DIAGRAMS OF PROCESSES USED IN THE DETECTION OF POISONS.

TESTS FOR SULPHURIC ACID.

When chloride of barium is added to a solution containing sulphuric acid, water is decomposed, hydrochloric acid being formed, and sulphate of baryta precipitated, insoluble in nitric acid.

Chloride of Barium, 1 eq.	Chlorine....	1	—— 1 Hydrochloric Acid.
	Barium	1	
Water, 1 eq. ...	Hydrogen ..	1	
	Oxygen	1	
Sulphuric Acid		1	—— 1 Sulphate of Baryta.

The sulphate of baryta being heated with charcoal, the 4 eqs. of oxygen contained in the sulphate unite with 4 eqs. of carbon, to form 4 eqs. of carbonic oxide, which are expelled, while the sulphur forms a sulphuret with the barium.

Carbon...............................			4	—— 4 Carbonic Oxide.
Sulphate of Baryta, 1 eq.	Sulphuric Acid .	Oxygen..	3	
		Sulphur .	1	
	Baryta........	Oxygen .	1	
		Barium .	1	—— 1 Sulphuret of Barium.

To the sulphuret of barium thus obtained hydrochloric acid is added, chloride of barium is formed, and hydrosulphuric acid given off, which may be known by its blackening paper moistened with a solution of acetate of lead and held over the fumes.

Hydrochloric Acid, 1 eq.	Hydrogen..	1	—— 1 Hydrosulphuric Acid.
	Chlorine ...	1	
Sulphuret of Barium, 1 eq.	Sulphur ...	1	
	Barium....	1	—— 1 Chloride of Barium.

TESTS FOR OXALIC ACID.

Composition of Dry Acid. $\begin{cases} 3 \text{ Oxygen} = 24 \\ 2 \text{ Carbon} = 12 \end{cases}$

$$\overline{36} \text{ Equivalent.}$$

Composition of Crystals.	1 Oxalic Acid	= 36
	3 Water	= 27
		63 Equivalent.

When chloride of calcium is added to a solution containing oxalic acid, hydrochloric acid is formed, and a heavy white oxalate of lime thrown down, soluble in nitric acid, but not in hydrochloric acid, unless in excess.

Chloride of Calcium, 1 eq.	Chlorine.... 1	1 Hydrochloric Acid.
	Calcium 1	
Water, 1 eq....	Hydrogen .. 1	
	Oxygen 1	
Oxalic Acid	1	1 Oxalate of Lime.

Sulphate of copper causes a greenish white precipitate of oxalate of copper, not dissolved by a small quantity of hydrochloric acid, but completely so in an excess of the acid.

Sulphate of Copper	Sulphuric Acid.	Free.
	Oxide of Copper	
Oxalic Acid....................		Oxalate of Copper.

When chalk has been taken as an antidote, an insoluble oxalate of lime is already formed; this must be boiled with carbonate of potassa; oxalate of potassa and carbonate of lime are thus formed; the former is held in solution, the latter is precipitated.

Carbonate of Potassa	Potassa......	Oxalate of Potassa.
	Carbonic Acid	
Oxalate of Lime....	Oxalic Acid..	
	Lime........	Carbonate of Lime.

Acetate of lead is next added to the solution of oxalate of potassa, oxalate of lead is thrown down, and acetate of potassa remains in solution.

Oxalate of Potassa..	Potassa......	Acetate of Potassa.
	Oxalic Acid..	
Acetate of Lead....	Acetic Acid..	
	Oxide of Lead	Oxalate of Lead.

Water is then mixed with the oxalate of lead, in order that a stream of hydrosulphuric acid may be passed through it.

Oxalate of Lead....	Oxalic Acid......	Oxalic Acid free.
	Oxide of Lead: Oxygen	Water.
	Oxide of Lead: Lead..	
Hydrosulphuric Acid	Hydrogen	
	Sulphur	Sulphuret of Lead.

The free oxalic acid may be again subjected to the preceding tests.

TESTS FOR HYDROCHLORIC ACID.

When nitrate of silver is added to a solution containing hydrochloric acid, water and chloride of silver are the results.

Nitrate of Silver....	Nitric Acid		Nitric Acid free.
	Oxide of Silver	Oxygen	Water.
		Silver..	
Hydrochloric Acid..	Hydrogen........		
	Chlorine		Chloride of Silver.

Chloride of silver is insoluble in nitric acid, and is not decomposed by heat, but fuses, assuming the appearance of horn, and is thence termed horn silver.

TESTS FOR ARSENIOUS ACID.

When a stream of sulphuretted hydrogen is passed through a solution containing arsenious acid, water and yellow sesquisulphuret of arsenic are formed.

Arsenious Acid, 1 eq.	Oxygen 3	3 Water.
	Arsenicum.. 2	
Hydrosulphuric Acid, 3 eqs.	Hydrogen .. 3	
	Sulphur 3	1 Sesquisulphuret of Arsenic.

When sesquisulphuret of arsenic is mixed with black flux (a mixture of carbonate of potassa and carbon) and heated, the carbonic acid of the carbonate is driven off, and the oxygen of the potassa unites with free carbon, forming carbonic oxide, which is also expelled. The sulphur of the sesquisulphuret combines with the deoxidized potassium, forming a sulphuret, whilst the arsenicum is sublimed and deposited on the sides of the tube. A portion of arsenicum also combines with a little potassium.

Sesquisulphuret of Arsenic.	Arsenicum ..	Arsenicum sublimes.
	Sulphur	Sulphuret of Potassium.
Black Flux	Carbonic Acid	Carbonic Acid driven off.
	Oxygen	
	Potassium ...	
Carbon....................		Carbonic Oxide driven off.

By heating the metallic arsenic, thus obtained, in contact with the air, arsenious acid is formed; this may be next tested by the ammoniaco-sulphate of copper and ammoniaco-nitrate of silver, the former causing a precipitate of arsenite of copper named Scheeles' green, the latter of a yellow arsenite of silver named Queen's Yellow.

PROCESS FIRST.

Ammoniaco-Sulphate of Copper.	Ammonia	Sulphate of Ammonia.
	Sulphuric Acid	
	Oxide of Copper	
Arsenious Acid		Arsenite of Copper.

PROCESS SECOND.

Ammoniaco-Nitrate of Silver.	Ammonia	Nitrate of Ammonia.
	Nitric Acid	
	Oxide of Silver	
Arsenious Acid		Arsenite of Silver.

When arsenious acid is mixed with charcoal and heated, metallic arsenic sublimes, giving off a garlic odour.

Arsenious Acid.	Arsenicum	Arsenicum sublimes.
	Oxygen	
Carbon		Carbonic Acid and Oxide.

MARSH'S TEST.

When zinc, sulphuric acid, and a solution of arsenious acid are placed in a vessel furnished with a stop-cock, the water is decomposed, the oxygen of which combines with the zinc, forming an oxide with which the sulphuric acid unites to form a sulphate. Part of the hydrogen of the decomposed water combines with the oxygen of the arsenious acid and forms water, the rest of the hydrogen unites with the metallic arsenic, forming arseniuretted hydrogen, which is allowed to escape through the stop-cock. The gas is then inflamed and the results of combustion, (namely, metallic arsenic, arsenious acid, and water,) are collected on a plate of glass held horizontally over the flame. The following diagram shows a more precise view of the changes which occur.

Arsenious Acid, 1 eq.	Arsenicum 2	2 Arseniuretted Hydrogen.
	Oxygen 3	
Water, 5 eqs.	Hydrogen 2	
	Hydrogen 3	3 Water.
	Oxygen 5	
Zinc 5		
Sulphuric Acid 5		5 Sulphate of Zinc.

COMBUSTION OF ARSENIURETTED HYDROGEN.

Arseniuretted Hydrogen.	Arsenicum....	Metallic Arsenic.
	Hydrogen.....	
Atmospheric Oxygen		Arsenious Acid.
Atmospheric Oxygen		Water.

TESTS FOR BICHLORIDE OF MERCURY.

When protochloride of tin is added to a solution of bichloride of mercury, the protochloride of tin takes 1 equivalent of chlorine from the bichloride and precipitates calomel. When more protochloride of tin is added, it takes the remaining equivalent of chlorine from the calomel, and metallic mercury is left, which may be distinctly seen after the bichloride of tin has been removed.

Protochloride of Tin		1	———	1 Bichloride of Tin.
Protochloride of Tin		1	———	1 Bichloride of Tin.
Bichloride of Mercury, 1 eq.	Chlorine	1		
	Chlorine	1		
	Mercury	1	———	1 Metallic Mercury precipitated.

SECOND TEST.

When two equivalents of iodide of potassium are added to a solution of bichloride of mercury, double decomposition takes place. Two equivalents of chlorine unite with two of potassium forming two equivalents of chloride of potassium, which remain in solution; the two equivalents of iodine combine with one of mercury to form biniodide of mercury, which is precipitated in the form of a bright scarlet coloured powder.

Iodide of Potassium, 2 eqs.	Potassium	2	———	2 Chloride of Potassium.
	Iodine	2		
Bichloride of Mercury, 1 eq.	Chlorine	2		
	Mercury	1	———	1 Biniodide of Mercury.

Biniodide of mercury is alternately dissolved and thrown down by iodide of potassium and bichloride of mercury. Chloride of sodium dissolves it entirely.

THIRD TEST.

When a drop of a solution of bichloride of mercury is placed on a piece of polished gold, and the moistened surface touched with a piece of iron, a galvanic current is produced which decomposes the bichloride. The mercury forms a white amalgam with the gold at the negative pole, and the chlorine unites with the iron at the positive pole.

Gold		———	Amalgamate.
Bichloride of Mercury.	Mercury		
	Chlorine		
Iron		———	Chloride of Iron.

FOURTH TEST.

Solution of potassa being added to bichoride of mercury produces two equivalents of chloride of potassium, which are held in solution, and precipitates one equivalent of binoxide of mercury in the form of a yellow powder.

Potassa, 2 eqs.	Potassium	2	———	2 Chloride of Potassium.
	Oxygen	2		
Bichloride of Mercury, 1 eq.	Chlorine	2		
	Mercury	1	———	1 Binoxide of Mercury.

FIFTH TEST.

Lime-water, also, added to bichloride of mercury throws down a precipitate of binoxide, but in this case the colour is of a *reddish* yellow tint.

SIXTH TEST.

Ammonia added to a solution of bichloride gives a white flocculent precipitate of ammonio-chloride of mercury, (for the decomposition see the Pharmacopœial preparation.)

TESTS FOR POTASSIO-TARTRATE OF ANTIMONY.

Potassa throws down the oxide of antimony, which is redissolved by an excess of the alkali.

Potassio-Tartrate of Antimony.	Tartrate of Potassa		Tartrate of Potassa (in solution.)
	Ditartrate of Antimony.	Oxide of Antimony	Oxide of Antimony (precipitated.)
		Tartaric Acid	
Potassa			Tartrate of Potassa (in solution.)

Lime water throws down a mixed precipitate of tartrate of lime and oxide of antimony.

Potassio-Tartrate of Antimony.	Tartrate of Potassa		Tartrate of Potassa in solution.	
	Ditartrate of Antimony.	Oxide of Antimony	Oxide of Antimony	Pre-cipi-tated.
		Tartaric Acid		
Lime			Tartrate of Lime.	

The best test for potassio-tartrate of antimony is hydrosulphuric acid. To detect it in mixed fluids Dr. Turner advises the following process: Boil the liquid for a few minutes with about a drachm of hydrochloric and tartaric acids. The tartaric acid dissolves any oxide of antimony that may have been thrown down by the antidotes administered, such as infusion of bark, galls, tea, &c. The use of the hydrochloric acid is to coagulate any animal matter present. Hydrosulphuric acid is now passed through the liquid, and a red sesquisulphuret of antimony is precipitated. The precipitate having been dried is then to be placed in a glass tube and a stream of hydrogen gas passed slowly through it. The hydrogen takes the sulphur, forming hydrosulphuric acid, which escapes, leaving metallic antimony, easily known by its lustre. The tube must be heated by means of a spirit-lamp at the part where the sulphuret is placed.

A.

Potassio-tartrate of Antimony.	Tartrate of Potassa		Tartrate of Potassa.
	Ditartrate of Antimony.	Tartaric Acid.	Tartaric Acid, free.
		Oxygen	Water.
		Antimony	
Hydrosulphuric Acid.	Hydrogen		
	Sulphur		Sesquisulphuret of Antimony.

B.

Sesquisulphuret of Antimony.	Antimony ————	Metallic Antimony.
	Sulphur ..	
Hydrogen	————	Hydrosulphuric Acid.

TESTS FOR LEAD.

Hydrosulphuric acid throws down a black sulphuret of lead.

Acetate of Lead.	Acetic Acid ..... ————	Acetic Acid, free.
	Oxygen .... ————	Water.
	Lead	
Hydrosulphuric Acid.	Hydrogen.......	
	Sulphur .... ————	Sulphuret of Lead.

Iodide of potassium gives a yellow precipitate of iodide of lead.

Acetate of Lead.	Acetic Acid .... ————	Acetate of Potassa.
	Oxygen	
	Lead	
Iodide of Potassium.	Potassium......	
	Iodine .... ————	Iodide of Lead.

Chromate of potassa throws down a yellow chromate of lead.

Chromate of Potassa.	Potassa .... ————	Acetate of Potassa.
	Chromic Acid...	
Acetate of Lead.	Acetic Acid	
	Oxide of Lead .. ————	Chromate of Lead.

Alkalies and alkaline carbonates give white precipitates with soluble salts of lead, consisting of oxide and carbonate of lead.

Sulphuric acid throws down a white sulphate of lead.

TESTS FOR COPPER.

FIRST TEST.

Ammonia added to a solution of a salt of copper seizes the acid and throws down the oxide of a pale blue colour, which is re-dissolved by an excess of the volatile alkali.

Ammonia	————	Sulphate of Ammonia.
Sulphate of Copper.	Sulphuric Acid	
	Oxide of Copper ...... ————	Oxide of Copper.

SECOND TEST.

When a polished piece of iron is put into a solution of sulphate of copper, sulphate of iron is formed and copper deposited in the metallic state.

Iron	————	Sulphate of Iron.
Sulphate of Copper.	Sulphuric Acid	
	Oxygen	
	Copper .... ————	Metallic Copper.

When copper is contained in mixed fluids, hydrosulphuric acid is the best test. The resulting sulphuret having been collected and heated to redness that the organic matter may be charred, is next to be placed on a piece of porcelain and digested with nitric acid. The sulphuret is converted into a sulphate at the expense of the nitric acid, and may be submitted to the re-action of the foregoing tests.

A.

Sulphate of Copper.	Sulphuric Acid ..	Sulphuric Acid, free.
	Oxygen	Water.
	Copper	
Hydrosulphuric Acid.	Hydrogen	
	Sulphur	Sulphuret of Copper.

B.

Nitric Acid.	Nitrogen	Nitrogen.
	Oxygen	
Sulphuret of Copper.	Sulphur	
	Copper	Sulphate of Copper.

TESTS FOR MORPHIA.

Nitric acid added to morphia causes it to assume an orange-red colour soon changing to yellow.

Morphia is dissolved by sesquichloride of iron, producing a deep greenish blue solution.

When iodic acid is added to morphia, the acid is decomposed, and the iodine set free, which forms a blue colour with starch.

TEST FOR MECONIC ACID.

When a persalt of iron is added to a solution containing meconic acid, a deep cherry or blood-red colour is produced, which is permanent on the addition of potassa or bichloride of mercury. Sulpho-cyanic acid gives a similar colour with a persalt of iron, but it is destroyed by potassa or bichloride of mercury. When an organic mixture is the subject of investigation it is to be freed in the usual manner from all insoluble matter, and from colour. To the solution containing meconate of morphia, acetate of lead is added, and the following decomposition ensues.

The solution.	Morphia	Acetate of Morphia.
	Meconic Acid	
Acetate of Lead.	Acetic Acid	
	Oxide of Lead	Meconate of Lead.

The meconate of lead is then suspended in water and sulphuretted hydrogen passed through it; sulphuret of lead is formed, and the meconic acid is obtained free.

Meconate of Lead.	Meconic Acid	——————Meconic Acid.
	Oxygen	——————Water.
	Lead	
Sulphuretted Hydrogen.	Hydrogen	
	Sulphur	——————Sulphuret of Lead.

The solution from which the meconic acid has been removed by the acetate of lead, contains acetate of morphia, to this ammonia is added, which unites with the acetic acid, and the morphia is precipitated.

Ammonia		——————Acetate of Ammonia.
Acetate of Morphia.	Acetic Acid	
	Morphia	——————Morphia.

The following TABLE shows the CLASSES into which Simple Bodies are divided, their NAMES, CHEMICAL EQUIVALENTS, SPECIFIC GRAVITIES, and the COMPOUNDS which they form with Oxygen.

Class.	Name.	Equiv.	Sp. Gr.	Compounds with Oxygen.
Simple Gases.	Oxygen	8	1·102	
	Hydrogen ...	1	0·069	Water, 1 Hyd. 1 Ox. Peroxide, 1 Hyd. 2 Ox.
	Nitrogen	14	0·972	Protoxide, 1 Nit. 1 Ox. Binoxide, 1 Nit. 2 Ox. Hyponitrous Ac., 1 Nit. 3 Ox. Nitrous Ac., 1 Nit. 4 Ox. Nitric Ac., 1 Nit. 5 Ox.
	Chlorine	36	2·47	Hypochlorous Ac., 1 Chl. 1 Ox. Chlorous Ac., 1 Chl. 4 Ox. Chloric Ac., 1 Chl. 5 Ox. Perchloric Ac., 1 Chl. 7 Ox.
	Fluorine	18	1·060	
Simple Non Metallic Substances.	Carbon	6		Carbonic Oxide, 1 Carb. 1 Ox. Carbonic Ac., 1 Carb. 2 Ox. Oxalic Ac., 2 Carb. 3 Ox.
	Sulphur	16	1·99	Sulphurous Ac., 1 S. 2 Ox. Hyposulphurous Ac., 2 S. 2 Ox. Sulphuric Ac., 1 S. 3 Ox. Hyposulphuric Ac., 2 S. 5 Ox.
	Selenium	40	4·3	Oxide, 1 Sel. 1 Ox. Selenious Ac., 1 Sel. 2 Ox. Selenic Ac., 1 Sel. 3 Ox.
	Phosphorus ..	16	1·77	Oxide, 3 Phos. 1 Ox. Hypophosphorous Ac., 2 Phos. 1 Ox. Phosphorous Ac., 2 Phos. 3 Ox. Phosphoric Ac., 2 Phos. 5 Ox.
	Iodine	126	4·948	Oxide of Iodine, Iodous Ac., Composition unknown. Iodic Ac., 1 Iod. 5 Ox. Periodic Ac., 1 Iod. 7 Ox.
	Boron	20	2·	Boracic Ac., 1 Bor. 3 Ox.
	Bromine	78	2·738	Bromic Ac., 1 Brom. 5 Ox.
	Silicon	22		Silicic Ac., 1 Sil. 3 Ox.
Metallic bases of Alkalis.	Potassium ...	40	0·865	Potassa, 1 Pot. 1 Ox. Peroxide of Potassium, 1 Pot. 3 Ox.
	Sodium	24	0·972	Soda, 1 Sod. 1 Ox. Peroxide of Sodium, 2 Sod. 3 Ox.
	Lithium	8		Lithia, 1 Lith. 1 Ox.
Metallic bases of Alkaline Earths.	Barium	68	Unknown	Protoxide, 1 Ba. 1 Ox. Peroxide, 1 Ba. 2 Ox.
	Strontium ...	44	Do.	Protoxide, 1 Str. 1 Ox. Peroxide, 1 Str. 2 Ox.
	Calcium	20	Do.	Lime, 1 Cal. 1 Ox. Peroxide, 1 Cal. 2 Ox.
	Magnesium ..	12	Do.	Magnesia, 1 Mag. 1 Ox.

Metallic bases of Earths.	Aluminum ..	10	Unknown	Alumina, 2 Alumin. 3 Ox.
	Glucinium ..	18	Do.	Glucina, 1 Gl. 3 Ox.
	Yttrium	32	Do.	Yttria, 1 Ytt. 1 Ox.
	Thorium	60	Do.	Thorina, Composition unknown.
	Zirconium ..	22	Do.	Zirconia, 2 Zir. 3 Ox.
Metals which decompose Water at a red heat.	Manganese ..	28	8·013	Protoxide, 1 Ma. 1 Ox. Sesq. Oxide, 2 Ma. 3 Ox. Peroxide, 1 Ma. 2 Ox. Red Oxide, 3 Ma. 4 Ox. Manganic Ac., 1 Ma. 3 Ox. Permanganic Ac., 2 Ma. 7 Ox.
	Zinc	32	7·	Protoxide, 1 Zi. 1 Ox. Peroxide, Composition uncertain.
	Iron	28	7·7	Protoxide, 1 Ir. 1 Ox. Peroxide, 2 Ir. 3 Ox. Black Oxide, 3 Ir. 4 Ox.
	Tin	58	7·291	Protoxide, 1 Tin, 1 Ox. Sesq. Oxide, 2 Tin, 3 Ox. Binoxide, 1 Tin, 2 Ox.
	Cadmium ...	56	8·604	Oxide, 1 Cad. 1 Ox.
	Cobalt	30	7·834	Protoxide, 1 Cob. 1 Ox. Deutoxide, 3 Cob. 4 Ox. Peroxide, 2 Cob. 3 Ox.
	Nickel	28	8·279	Protoxide, 1 Ni. 1 Ox. Peroxide, 2 Ni. 3 Ox.
Metals which do not decompose Water at a red heat, and the Oxides of which are not decomposed by heat alone.	Arsenic	38	5·884	Arsenious Ac., 2 Ar. 3 Ox. Arsenic Ac., 2 Ar. 5 Ox.
	Chromium ..	28	5·	Sesq. Oxide, 2 Chr. 3 Ox. Chromic Ac. 1 Chr. 3 Ox.
	Vanadium ...	68	Unknown	Protoxide, 1 Van. 1 Ox. Binoxide, 1 Van. 2 Ox. Vanadic Ac., 1 Van. 3 Ox.
	Molybdenum .	48	8·6	Protoxide, 1 Mo. 1 Ox. Binoxide, 1 Mo. 2 Ox. Molybdic Ac., 1 Mo. 3 Ox.
	Tungsten	100	17·4	Binoxide, 1 Tung. 2 Ox. Blue Oxide, 2 Tung. 3 Ox. Tungstic Ac., 1 Tung. 3 Ox.
	Columbium ..	185	Unknown	Binoxide, 1 Col. 2 Ox. Columbic Ac., 1 Col. 3 Ox.
	Antimony ...	65	6·7	Sesq. Oxide, 2 Ant. 3 Ox. Antimonious Ac., 2 Ant. 4 Ox. Antimonic Ac., 2 Ant. 5 Ox.
	Uranium	217	Unknown	Protoxide, 1 Ur. 1 Ox. Peroxide, 2 Ur. 3 Ox.
	Cerium	48	Do.	Protoxide, 1 Ce. 1 Ox. Peroxide, 2 Ce. 3 Ox.
	Bismuth	72	10·	Protoxide, 1 Bism. 1 Ox. Peroxide, 2 Bism. 3 Ox.
	Titanium	24	5·3	Oxide, 1 Ti. 1 Ox. Titanic Ac., 1 Ti. 2 Ox.
	Tellurium ...	32	6·257	Tellurous Ac., 1 Tell. 2 Ox. Telluric Ac., 1 Tell. 3 Ox.
	Copper	32	8·667	Dinoxide, 2 Co. 1 Ox. Protoxide, 1 Co. 1 Ox. Super Oxide, 1 Co. 2 Ox.
	Lead	104	11·381	Dinoxide, 2 Le. 1 Ox. Protoxide, 1 Le. 1 Ox. Peroxide, 1 Le. 2 Ox. Red Oxide, 3 Le. 4 Ox.
Metals whose Oxides are decomposed by a red heat.	Mercury	202	13·545	Protoxide, 1 Mer. 1 Ox. Peroxide, 1 Mer. 2 Ox.
	Silver	108	10·51	Oxide, 1 Sil. 1 Ox.
	Gold	200	19·3	Protoxide, 1 Go. 1 Ox. Binoxide, 1 Go. 2 Ox. Peroxide, 1 Go. 3 Ox.
	Platinum	98	21·25	Protoxide, 1 Pla. 1 Ox. Binoxide, 1 Pla. 2 Ox. Sesq. Oxide, 2 Pla. 3 Ox.
	Palladium ...	54	11·3	Protoxide, 1 Pall. 1 Ox. Binoxide, 1 Pall. 2 Ox.
	Rhodium	52	11·	Protoxide, 1 Rho. 1 Ox. Peroxide, 2 Rho. 3 Ox.
	Osmium	100	7·	Protoxide, 1 Os. 1 Ox. Sesq. Oxide, 2 Os. 3 Ox. Binoxide, 1 Os. 2 Ox. Peroxide, 1 Os. 3 Ox. Osmic Ac., 1 Os. 4 Ox.
	Iridium	98	15·862	Protoxide, 1 Irid. 1 Ox. Sesq. Oxide, 2 Irid. 3 Ox. Binoxide, 1 Irid. 2 Ox. Peroxide, 1 Irid. 3 Ox.

TESTS FOR THE MORE COMMON SPECIES OF CALCULI.

1. Uric or lithic acid calculus is of a brownish colour and laminated texture, and has a smooth surface. Before the blowpipe it blackens, giving off an ammoniacal odour, and is gradually consumed, leaving a minute portion of white ash. It is soluble in potassa and in nitric acid, the latter solution yielding on evaporation purpurate of ammonia, known by its fine purple colour;—in water and hydrochloric acid it is sparingly soluble.

2. Phosphate of lime calculus is of a pale brown colour and loosely laminated texture; its surface is smooth. Before the blowpipe it first blackens and then assumes a white colour, remaining unchanged, unless the heat be very intense, when it fuses;—in potassa it is insoluble, but is soluble in dilute nitric and hydrochloric acids.

3. Phosphate of ammonia and magnesia calculus is of a whitish colour. Before the blowpipe ammonia is given off, and phosphate of magnesia left. Its solution in hydrochloric acid is not affected by oxalate of ammonia;—it is soluble in cold acetic acid.

4. The fusible calculus is a mixture of the two former species; its colour is white, and it is very friable, resembling chalk. Before the blowpipe it easily fuses into a pearly globule; acetic acid dissolves the phosphate of ammonia and magnesia, and the phosphate of lime which is left is soluble in hydrochloric acid. From the latter solution, oxalate of ammonia throws down oxalate of lime.

5. The oxalate of lime or mulberry calculus is of a dark brown colour, and hard texture; its surface is tuberculated. Before the blowpipe the oxalic acid is decomposed, and pure lime remains. This calculus is not dissolved by the alkalies but is decomposed by carbonate of potassa, an insoluble carbonate of lime being formed;—it is insoluble in acetic and phosphoric acids, and is thus distinguished from the phosphate of ammonia and magnesia, and from the phosphate of lime calculi.

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